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BULLETIN
OF THE
STATE UNIVERSITY OF NEW MEXICO

Whole Number 116.

Educational Series January, 1924. Vol. III No. 1

A SCIENTIFIC SYMPOSIUM

ABSTRACTS OF PAPERS AND ADDRESSES

NEW MEXICO ASSOCIATION FOR SCIENCE

EIGHTH ANNUAL MEETING

November 27, 28, 1923, East Las Vegas

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Published by the State University
Albuquerque, New Mexico
1924.

ENTERED MAY 1, 1906,
AT ALBUQUERQUE, NEW MEXICO
AS SECOND-CLASS MATTER, UNDER ACT OF CONGRESS
OF JULY 19, 1894.

PREFACE

The Abstracts contained herein indicate the scope of the work of the members of the New Mexico Association for Science, as revealed in the studies reported at the Eighth Annual Meeting.

The State University of New Mexico is pleased to encourage the work of the Association by printing this record of that interesting meeting. The Abstracts here printed necessarily have been compressed, and do not adequately set forth either the detail of the actual presentations or the profitable discussions which followed in many instances.

January 15, 192. **W. E. BOWMAN.**

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PHILOSOPHICAL AND PRACTICAL ASPECTS
OF THE
MIND-BODY RELATION

DAVID S. HILL, Ph. D., LL. D.
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By way of introduction the speaker called attention, for clearness, to the threefold aspects of every-day experience as viewed respectively by the physicist, the physiologist or anatomist, and the psychologist. To enjoy the sunlight, for example, involves consideration, (1) of energy or ether waves, (2) of photo-chemical action in the retina and of other physiological changes in optic nerve and brain, and (3) the perceptual or recognitive or emotional consciousness of light.

The discussion was limited to brief expositions of the following five topics as necessary subdivisions of the general subject:

I.—The Physiological Substrate of Mental Life, Particularly the Nervous System.

The important structural features are the **neurones.** The gross anatomy subdivides conveniently into brain, spinal cord, sympathetic system, ganglia, and also the sense organs, such as eye, ear, skin, tongue, muscle spindles—these organs conditoning a dozen kinds of sensation. No less important for understanding are the **functional** characteristics of the nervous system, such as the powers of conductivity, co-ordination, plasticity, growth, regeneration, rhythm, economy. Here reference was made to the work of His, Waldemeyer, Golgi, Cajal, Donaldson.

II.—Introspective Analysis of Mental Life:

The one "indubitable thing is the fact of consciousness and selfhood." Reference was made to the work of Des Cartes, Wundt, Mach, Ribot, Myers, Titchener, Hall, Judd, Angell and Pillsbury in the development of complete descriptions and analyses of human consciousness—the inescapable reality known directly as opposed to the concept **matter.** For example, a simple act, as handling a good apple, involves sensations—gustatory, olfactory, visual, tactual, as well as ideas of memory and imagination and also emotional factors. The inadequacy even of the rich English language to express the complexity and range of mental life was illustrated.

III.—The Facts of Mind-Body Interdependence:

Prior to appraisal of the different solutions which philosophy offers in its search for a universal explanation of things, a summary of the definite evidences that there is an interdependence between the psychic and the physical, the mind and the body, is convenient. These evidences are from four sources, namely:

(a) The facts of common observation—e. g. lack of food and hunger.

(b) The facts of pathology—e.g., the amnesias and aphasias.
(c) The facts of comparative anatomy—e.g., contrast cerebral structures and the intelligence of the guinea pig and of man.
(d) The facts of the psychological laboratory—e. g., the work of Pavlow on secretion, or the Hopkins experiments with sphygmograph and plethysmograph.

IV.—Philosophical Explanation:

The speaker explained how any attempt to state concisely the historical explanations offered by philosophy dealing with the mystery of the mind-body relation, inevitably arouses questions in ontology and epistemology as well as the more general methaphysical problems. By way of illustration he pointed to the various philosophical solutions with a brief exposition of the nature and difficulties of each, as follows:

- **Monism**
  - Materialism
  - Spiritualism
- **Dualism**
  - Parallelism
  - Interaction
- **Pluralism**

The history of philosophy—tracing the development of the doctrines through Democritus, Plato, Aristotle, Des Cartes, Paulsen, Eucken, and James, can be made a stimulating study for mature students under a wise teacher.

V.—The Practical Bearings:

In addition to the disciplinary and culturistic values in this day of superficial thinking, other possible educational values in thorough study of the mind-body problem, the speaker indicated, might be derived as they bear helpfully upon the questions of:

(1) Health and quackery;
(2) Pseudo-psychology, phrenology, telepathy and spiritism;
(3) Learning and practice in the schools;
(4) Reality of the external and ideational worlds.

THE RELATIONSHIP BETWEEN METHODS OF MEASUREMENTS AND THE ADVANCEMENT OF SCIENCE.

A. O. BOWDEN, A. M.,
President New Mexico State Teachers College, Silver City, New Mexico

The Ancient Greeks were more philosophical than scientific. They could not be truly scientific in the modern sense of the term. They lacked a definite system and method of measurement. Two things are necessary to the advancement of science, the scientific attitude and accurate, objective standards of measurement.

Science in our modern sense did not begin to develop until the latter part of the Renaissance period, until the invention of such instruments of measurement as the telescope, the microscope, etc. Had it not been for accurate measurers of electrical currents such as the Watt, the Ampere, etc., the discovery of Benjamin Franklin would have been of but little value.

Measurement is not identical with mathematics. Measurement is a method of procedure, a check upon our thinking. The Greeks of old had nothing to check up with their thinking and consequently shot wild in their conclusions.

Not all who hold advanced degrees are equipped with that rare spirit and attitude that is willing to take on face value results experimentally determined. Many are controlled by propaganda. Others have closed minds about facts that they do not understand. Science has always had to battle with the prejudice of its avowed devotees. The pages of the history of science is strewn with examples of this opposition. Kepler and his work, Copernicus, Harvey and the circulation of the blood, Darwin, Einstein and Freud. Today we meet with opposition from unexpected quarters to the ideas of intelligence tests and educational measurement, which is a parallel to the opposition in the above mentioned examples. But until we can at least crudely measure a phenomenon we can not say we have knowledge of that thing. Our knowledge of a phenomenon extends to the limit of our measuring rod.

GENERAL CHEMISTRY A PART OF A LIBERAL EDUCATION.

WALTER ARTHUR, M. S.
Professor of Chemistry, New Mexico School of Mines, Socorro, New Mexico

Teachers of general Chemistry, especially those in the high schools, are confronted with the persistent demand that this subject be presented from the standpoint of immediate application. This is always the path of the least resistance and it brings immediate popular approval. While such instruction is commendable there are certain facts to be kept in mind which would indicate to us the value of instruction along theoretical lines.

No student from the high school will be able to make a very great application of anything that may be presented ni a high school course in general chemistry or from a similar course in college. In fact, only a very limited number pursue the study of chemistry further than this. Such being the case, it is far better that General Chemistry be presented on just as broad a basis as possible. This is evident when we consider this subject, as all subjects must be considered, as a part of his liberal education in the years that are ahead. As a student leaves his school days further and further behind, the courses of instruction tend to blend into a more or less distinct composite. If the course in general chemistry has not been of a character that it tends to blend into this composite, much of its value has been lost. Special features of any subject leading to an immediate application are, very often, superseded by something else as time goes on, while the more general laws will be as true in the future as at present.

The plea for general chemistry is that it may not be allowed to degenerate into a course in simple technology, but that it be kept on the high planes of broad principles. In view of the fact that many of our teachers have been trained in general chemistry along the more technical lines, it becomes difficult for them to instruct along the lines of the broader principles. But when it is possible to present in an acceptable manner these larger and broader facts, the instruction is correspondingly enhanced in its value. Technique and ideas intended for immediate application do not tend to develop men and women of prophetic vision and high ideals. The trend of developments in the political world at the present hour indicate very clearly that we must develop men and women who can prepare policies for the future. Our civilization can not long exist without the careful direction on the part of far-sighted people.

The teacher of chemistry who would best serve the class-room must first have an extensive knowledge of the science of material relations, and the ability to interpret and present these laws in the language of the student and in harmony with the trend of the age. When these conditions will have been met, the study of chemistry will be a real contribution to a liberal education.

Among the features of a liberal education may be mentioned the following: That which disciplines the mind, deepens human understanding, gives appreciation of the natural world, develops prophetic vision and assists in bringing the mind into harmony with the great impelling forces of the human family. General chemistry can be presented so that it may contribute to all of these. It will not fulfill its mission until it has done so.

A STANDARD MINIMUM HIGH SCHOOL COURSE IN CHEMISTRY.

JOHN D. CLARK, Ph. D.

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The Committee on Chemical Education of the American Chemical Society has been at work for more than a year correlating the courses of high school and college chemistry.

The Committee decided,(and the A. C. S. concurred in the decision,) that the four following objectives would help most in solving the correlation problem:

1. To encourage the teaching of chemistry in the high school.
2. To have such a course given in high school that it would answer for students who go to college as well as for students who do not go to college.
3. To outline a minimum high school chemistry course, taking into account both content and method.
4. To have colleges recognize high school chemistry, at least to the degree of having a different course for those students who have had the said outlined high school course.

The following objectives have governed the Committee in its work:

1. To prepare an outline for high school chemistry which is satisfactory for students who wish to get a general knowledge of chemistry as well as for those who are going to college.
2. To list only the minimum essential topics which are common in all localities, so that the high school teacher will have time in developing the course to supplement these minimum topics with material which he considers suitable for his locality or for the future work of his students.
3. To prepare an outline which would cover the essentials of any State requirements.
4. To prepare an outline which would be in tune with the syllabus of the College Entrance Examination Board.

It is the anticipation of the Committee that the following objectives will govern the high school teacher in developing the outline:

1. To show the services of chemistry to the home, to health, to medicine, to agriculture, to industry, etc.—in a word, to show the service of chemistry to the Nation.

2. To develop this service in chemistry around these minimum standard topics, and, in so doing, to see that these minimum requirements are so well taught that they may be built upon as a foundation in college.

3. To use his own order in developing the listed topics.

4. To train the student in keen observation and exact reasoning.

5. To develop a careful correlation between recitation and experiment with the minimum amount of repetition.

6. To encourage students to keep notebooks which shall be an accurate record of laboratory experiences expressed in concise, clear English.

7. To encourage chemistry being placed in fourth year of high school after students have had a year of general science, and a year of biological science or physics, or preferably both.

8. To build upon the earlier science courses and knit them together in the best possible manner.

9. To encourage the use of reference books in addition to their text book.

10. To help students to find themselves—i. e., to discover whether they have an aptitude for further study in chemistry or applied science, and, if so, to encourage these students to continue their study of science in a university or technical school.

11. The teacher is urged thruout the course to stress the general principles involved in the specific cases studied.

Full details concerning the Minimum Course are to be found in Vol. 15, No. 11, page 1189, Industrial and Engineering Chemistry, and will be printed in the Journal of Chemical Education, a publication soon to appear.

THE MINING INDUSTRY AND MINERAL RESOURCES OF NEW MEXICO.

By E. H. WELLS, B. S., M. E.

President New Mexico School of Mines, Socorro, New Mexico

Among the industries of New Mexico, mining occupies a leading position. As a rule the value of the mineral products has exceeded that of either the livestock or agricultural industries, amounting to $27,883,565 in 1920.

In decreasing order of importance the chief mineral products of

New Mexico are coal, copper, silver, zinc, iron, and gold. In 1920 the value of the coal production was $13,568,000, while copper was worth $10,000,000. Thus coal and copper constitutes about 84 per cent of the total.

The most important coal deposits of the state are in the northern part The two chief coal regions are the San Juan Basin region lying mainly in McKinley, San Juan, and Rio Arriba Counties, and the Raton Mesa region in Colfax County. Two-thirds of the state's production comes from the Raton field. Most of the coal is bituminous and subbituminous, but some anthracite is mined in the Los Cerrillos field. Good coking coal is obtained in several localities. The total coal reserves are roughly one hundred and sixty-five billions of tons, or enough to last for fifty thousand years at the present rate of extraction.

Copper comes mainly from the Santa Rita mine of the Chino Copper Co., in Grant County. The Chino property is not only the most important mine in New Mexico, but it is also one of the great copper mines of the world. Dividends to date amount to almost $30,000,000, and 512,000,000 pounds of copper was produced prior to 1921. Ore reserves are estimated to be over 100,000,000 tons. The Burro Mountains branch of the Phelps Dodge Corporation is normally an important producer of copper ore and the Lordsburg mines yield much copper.

The Mogollon district in Catron County produces about half of the silver now mined in New Mexico, and silver is the chief metal in some of the Lordsburg ores. Silver-lead ores are mined in various districts, but the present output is not as large as it has been in past years. Lead ores containing very little silver have constituted an important part of the production from the Magdalena district.

Only two districts have been important producers of zinc in recent years—the Central district in Grant County and the Magdalena district in Socorro County. The important zinc mines of the Central district are near Hanover.

An unexpectedly large tonnage of iron ore is taken yearly from New Mexico deposits near Fierro, Grant County. Manganferous iron ore is being mined from a large deposit near Silver City. Many manganese deposits were worked during the war but most of them are now idle.

The placer gold yield, formerly very important, has dwindled to an insignificant amount, and most of the present production is from lode deposits. Some of the best known of the gold mines are the Old Abe mine in the White Oaks district, Lincoln County, the Aztec mine in Elizabethtown district, Colfax County, and the Pacific mine, Pinos Altos district, Grant County. The Mogollon ores carry gold as well as silver, and the Chino copper ores have an important gold content.

The mining of fluorite has attained considerable importance in the southwestern part of the state. Mica, molybdenum, and tungsten have been produced in moderate amounts. New Mexico turquoise workings have a large production to their credit and boast of a natoble antiquity.

Clay products, lime, gravel and stone are abundant and are being utilized in increasing amount.

Salt and gypsum in beds up to several hundred feet in thickness underlie areas of many hundreds of square miles in the southeastern part of the state. Distance from markets prevents their utilization.

After many disappointments, oil has at last been found in valuable amounts in the northwestern part of New Mexico. It is one of the highest grade oils ever found in underground reservoirs. Several promising structures will soon be tested. A number of wells drilled for oil have developed large flows of gas.

Other elements found in New Mexico in small or unproved amounts which may attain prominence in the future include tin, uranium, vanadium, radium, sulphur, graphite, meerschaum, and natural alum.

RADIO BROADCAST RECEIVING.

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Radio has recently become popular through the establishment of broadcasting stations. This is no passing fad, but is fast becoming a part of home life. Because of the newness and complications of this science, the public is demanding information regarding it. While the details of radio are more or less complicated, the fundamental principles are neither new nor complex. They are termed electro-magnetism and electro-induction. Electro-magnetism is the production of a state of stress in space surrounding an electric current. Electro-induction is the production of electric current by changing electric fields. In radio communication, electric fields are set up thruout all space by controlled electric currents at the transmitter. These electric fields are untilized at the receiver, by electro-induction, to set up currents, which vary in accordance with the controlled variations of the fields from the transmitter.

Radio waves are of two types, called damped and continuous. The former are utilized for telegraphy, and the latter, while necessary for telephony, may also be used for telegraphy. There is a definite relation between the frequency, wave length, and velocity of propagation of wave motions. The product of the frequency and wave length is equal to the velocity of travel, which for radio waves is the same as the velocity of light. Oscillations in all bodies occur most readily at a particular frequency, known as the natural period of the body. Making use of this principle, electric oscillations are separated and made more effective by ''tuning,'' or adjusting the natural period of oscillation of the receiving circuit to the ferquency of the transmitter it is desired to receive. The tuner is the device which, thru changes of the electrical constants of the receiving circuit, changes the natural period of that circuit at will. The detection of radio waves to the human mind is usually thru the sense of hearing, since the telephone receiver is a device which efficiently converts electrical oscillations into sound waves. The human ear responds only to vibrations of frequencies between 16 and 10,000 per second. These frequencies are called audio frequencies, some device must be used to convert the resulting radio are termed radio frequencies. Since radio waves oscillate at radio ferquencies, some device must be used to convert the resulting radio frequency currents into audio frequency currents to be used by the telephone receiver for conversion into sound waves. This device is the detector. Modern detectors are usually of the vacuum tube type.

Vacuum tubes may be used as detectors or rectifiers, and as amplifiers. As amplifiers, they may be used to build up weak radio frequency currents, or to increase the strength of rectified audio frequency currents. In either case, as many as three stages of amplification can be readily used, thereby building up to considerable strength very weak signals.

THE RELATION OF GRAZING CONTROL TO IRRIGATION AND AGRICULTURE IN THE SOUTHWEST

F. C. W. POOLER,

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Depletion of our original stock of desirable grasses in the Southwest, besides contributing heavily to the instability of the livestock industry, is causing abnormal erosion which threatens irrigation and agriculture. An example of this is the Zuni Indian Reservoir built in 1906 by the Government, which water 3,500 acres and cost $500,000, or $140 per acre. It was expected to last indefinitely and with a 100-year life, for instance, the capital charge would have been only $1.40 per acre. In 1918, however, this reservoir was half full of silt due to overgrazing of its watershed which had weakened or eliminated the sod and induced abnormal erosion. The reduction in estimated life from a century to 21 years increases the capital carrying charge to a figure which might have prevented construction had it been anticipated. But what is of immensely more importance, such carrying charges may prevent further investment in reclamation projects as they become known.

The Zuni Reservoir although probably an extreme case, typifies what is now recognized as a widely prevalent obstacle to reclamation, namely, rapid silting due to erosion of the watershed, short life due to rapid silting, heavy carrying charges due to short life, and reluctant capital due to heavy carrying charges. No generally practicable method of desilting is as yet known to engineers.

Further local examples of damage to reclamation through silting are the seepage of the Rio Grande Valley where, according to former Director Davis of the Reclamation Service, silting has raised the bed of the river and destroyed the natural drainage to its channel; the silting of Lake McMillan on the Pecos which is said to have amounted to 60 per cent in 15 years; the silting of Elephant Butte diversion works and canals; and the gradual silting of the Roosevelt Reservoir. Besides damage of this kind, direct destruction of agricultural lands by floods is going on extensively, which in the Southwest also affects the welfare of related livestock operations and increases livestock production costs. Much of the foregoing damage is attributable to overgrazing.

Control of overgrazing turns on the question of land tenure. In the Southwest our National Forests total 20,000,000 acres, Indian Reservations 23,000,000 acres, the public domain 30,000,000 acres, and private lands, including State and railroad lands, etc., 70,000,000 acres. Education coupled with self interest may conceivably in time induce proper range management on private lands. The grazing problem on the Indian reservations is susceptible of solution under Federal supervision. The grazing problem is in a fair way to be satisfactorily solved on the national forests within the next few years since conservation of range and watershed values ranks second only to timber production as one of the prime objectives of Forest Service administration.

The public domain of all four general classes is the worst sufferer under present conditions. It has been overgrazed and abused for years, is deteriorating in value and eroding badly, and its conservative management as opposed to its present neglect is essential to avoid continued losses to reclamation projects on the watersheds below and to the livestock industry itself.

Nine attempts to secure legislation for control of public domain grazing have been made since 1900 but have failed because of inability to agree as to what would be the best system.

Treatment of the situation locally by National Forest extensions requires special Congressional approval where non-timbered land is involved and is at best only a piece-meal remedy though preferable to none at all. Nothing short of general legislation for grazing control of the public domain will adequately meet the situation.

AGRICULTURE A REQUIRED HIGH SCHOOL SCIENCE

L. L. BURRELL, B. S.
Professor of Biology and Agriculture, New Mexico Normal University,
E. Las Vegas, N. M.

For over a century agriculture has been regarded by a few of the foremost educators as worthy a place in our public schools; but it is only within the last decade that the dream of these educators has approached realization. Agriculture, wherever well taught, has proved to be a source of strength to the school. And yet, there are many schools that do not offer any work in this subject.

Everybody is directly and vitally interested in agricultural products and comes into personal contact with them every day. Man cannot manufacture synthetic food, but is absolutely dependent upon plants and animals for his supply.

Agriculture is financially our most important industry. Our cereal crops are worth about a billion dollars more annually than our iron and steel industry. Our live stock is worth several times as much as the automobile industry, and our poultry products are worth more yearly than the combined value of all the gold, silver, iron and coal mined in the United States.

We should also consider the economic value of agriculture. Mr. O. H. Benson of the Federal Department of Agriculture, says that our population is increasing five times as fast as our food supply. This will, in a measure, account for the increased cost of living. It must also lead us to the conclusion that the cost of living will go higher, and that agriculture will become more important in the future.

History has proven that it is from the farms that cities recruit men to manage their big affairs. Washington and Jefferson were farmers. In their time, the opinion prevailed that the stability and welfare of a country depended upon the ratio between a sturdy, industrious, law abiding rural population, and a frivolous, pleasure-loving, rather immoral city population.

The study of agriculture as a science has a very high educational value. It develops administrative and executive ability; and has a high moral, aesthetic and religious value. As an art, agriculture is riculture. If all cit ypeople had this knowledge, they would be less derstand the principles underlying the laws of plant and animal developments, the maintainnig of soil fertility and the marketing of crops, it is necessary to have some knowledge of almost every science now known to man.

There is a great need for widespread accurate knowledge of ag- highly nutritious food, a miniature representation of herself (a calf), extravagant and wasteful in the use of food, and there would be less migration from the city to the farm and back again after a dismal failure. If country people generally knew the scientific principles of agriculture, they would not be contented with an average yield of fourteen bushels of wheat per acre, when they might grow thirty to fifty, nor with a dairy cow that produces four or five thousand pounds of milk a year if they knew that the world record cow produced over thirty-seven thousand pounds last year.

The subject of dairying is of special interest in New Mexico at this time. It takes a beef animal **two years** to produce 500 pounds of edible food and you must kill the animal to get the food. A medium grade dairy cow will produce in **one year** 10,000 pounds of highly nutritious food, a miniature representation of herself (a calf) and you still have your cow.

Every farmer should know that a dairy cow produces food just seven times as economically as a beef animal.

Conclusion: I consider agriculture worthy a place in every high school curriculum because: Everybody comes into direct contact with it daily. It is financially and economically our most important industry. It has a high educational value, and it is highly desirable that everybody possess accurate knowledge of this subject.

WHAT IS THE MATTER WITH OUR HIGH SCHOOL MATHEMATICS?

D. S. ROBBINS, Ph. D.

Professor of General Engineering, New Mexico College of Agriculture and Mechanic Arts, State College, New Mexico.

We recently conducted tests at State College to ascertain the extent of inadequate preparation of our Freshmen for the proper study of college mathematics. The result is astonishing and shows conclusively that we cannot depend on the approved High Schools to do this work without assistance. The only proper way to judge an institution is by its products; and, by this standard, our approved High Schools fail completely to give adequate preparation for the study of college mathematics.

I am sure we will all agree that it is not the only function of the high school to prepare its graduates for college. Most of them can never attend an institution of higher learning. Nevertheless, it is not demanding too much to insist that those students who graduate from approved schools that meet entrance requirements ''on paper,'' shall also possess the knowledge their certificates solemnly declare. The following tests may throw some light on the extent to which they fail to do this.

TEST ONE.

This test was given to a class of twenty-three freshmen, and represented sixteen high schools from five different states. It consisted of an entrance list of twenty-five years ago at a well-known college. The problems covered about what one would give to a class who had studied a very elementary work in algebra—Greatest Common Divisor, square root, and simple problems of rate, time, acceleration, work, etc., but no quadratics.

RESULT OF TEST ONE.

There were fourteen who made zero each; three made 5%; three made 10%; one made 15%; two made 20%. Not one of them came near passing. This would be funny if it were not pathetic. It is serious to handicap bright young college students in such a manner.

TEST TWO.

Test one suggested test two. I wanted to find out if any of them knew anything at all about this certified subject.

Fourteen bright fellows said $A^2 \times A^3 = A^{2x3}$

Nine of them said that it equals A^{2+3}

Fifteen said $A^6 \div A^2 = A^{6/2}$; and eight said A^{6-2}; twenty-two of them could not square $(A-B)$; not one of them could square $(3A-2B)$; not one of them could write the quotient of A^3-B^3 divided by $A-B$; none could factor or reduce the simplest fractions; some of them had a little knowledge of the equation; they all knew the ''Law of the Signs'' of multiplication and division.

The outstanding result, as revealed by these tests, is that not a single student of the twenty-three are prepared to take up the study of college algebra.

We will all admit that these tests at State College show a condition of unpreparedness that is simply ridiculous; and I happen to know that it is just as bad at the other institutions. But, we are accepting these unprepared students from approved High Schools into our Colleges, and as a result are turning out graduates who do not know enough algebra to do the simplest kind of scientific work.

A graduate from one of the great universities of the Middle West came to me recently to be tutored in algebra. I found that he knew but few of the working principles of the Subject, and his ignorance of the elements of college mathematics was astonishing. He said he wanted to ''cram'' enough ''Math.'' to teach in a high school. In all candor, this is serious. Just get the swing of the fatal circle. The colleges accept unprepared students and turn out unprepared graduates to each in the approved High Schools, to send them more unprepared students to furnish more unprepared teachers for the approved High Schools ets. This, at least, has the advantage of being a system. It hasn't a break, and runs true to form.

I have shown that a defect exists, and have no space left to discuss its cause and cure. Let me say, in a word, however, that to my mind it is wrong in principle and practice to permit any system of approvals to crowd our colleges with a ''mob'' of freshmen who are wholly unprepared to do college work. The high schools must improve their product in mathematics or lose approval, no matter how they stand with any organized system.

USE OF INTELLIGENCE TESTS AND RECLASSIFICATION OF PUPILS,

W. G. DONLEY, B.S., Superintendent of Schools, Carlsbad, N. M.

NOTE: The abstract of Mr. Donley's paper was unfortunately lost in the mails. Editor.

I. MEMORIZING AND FORGETTING.

II. MEMORY BY VISUAL AND BY AUDITORY PRESENTATION

D. A. WORCESTER, M. A.
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I. Memory has been a subject for discussion and experimentation, at least, since the time of Plato and undoubtedly, since a much earlier time. Careful laboratory work, however, on this subject, has been of relative recent date. Since the time of Ebbinghaus, we have accumulated a large volume of accurate knowledge concerning certain questions, such as the relation of quickness to tentativeness, relative value of the whole and particular methods of study and etc., and etc.

Little attention has been given to the relative value of memory for things seen as compared with things heard. We have been told a great deal in recent years about the necessity of visual training, and undoubtedly, all that we have been told was true. It is nevertheless, well to remember that the average person gathers a large proportion of information through the spoken work and it is desirable therefore, perhaps, to give formal auditory instruction as well as visual instruction.

As an attempt to answer in part the above question a group of students were asked to engage in the following experiment: On one day a hundred word prose selection from the works of Arnold or Huxley was read aloud by the whole method until the subject was able to reproduce it with an accuracy of at least 95%. On the following day the subject read a similar selection over and over to himself until able to reproduce it with an accuracy of 95% or more. Only one subject worker at a time, and only one selection a day was memorized. Some of the subjects learned first by the visual method and some learned by the auditory method.

A record was kept of the total learning time of each selection and after one day, two days and seven days, memory was tested by the method of retained numbers. No superiority of one method of learning over the other was found. Six of the subjects learned more rapidly by hearing the matter read to them and seven by reading it to themselves. Little connection was found between age and the rate of learning, the fourth most rapid memorizer of the thirteen being a woman 58 years of age.

It was startling to find however, that 11 of the 13 subjects remembered better the material heard than that seen. For the seven day test, the number who retained better that which was heard was 12.

It would appear then that there is an intrinsic superiority for retention in the auditory method of presentation. This of course, has an immense pedagogical significance, if it be borne out by further studies, particularly studies of children of school age. The above study employed as subjects adults exclusively.

As was expected, it was shown that those who learned most quickly had in general, retained best; although the age factor seems to have exerted a little influence in this respect.

The rate of forgetting in the above study, was found to be very much less than that shown in the studies of Ebbinghaus, Magneff and others. This difference is believed to result from the fact that the study under the discussion was given under much more nearly normal learning conditions than were most of the earlier studies. For example, Ebbinghaus' test of memory was the ability to reproduce at the same rate as the material was presented for learning, measured by a metronome. An additional factor, which may have been of large importance was the fact that in our experiment, but one selection was learned at a sitting. In most of the other studies, several selections were learned at a sitting, thereby, making probable retroactive inhibition. The results of the present study certainly seem to be more nearly in harmony with our experimental beliefs. There is no claim as to the finality of conclusions here stated, the whole problem requires and deserves a large amount of experimentation.

II. Memory has been the subject of philosophical interest from the time of Plato. It has only been during the past quarter of a century that valuable research work has been undertaken. Although much valuable data is at hand and many important questions concerning memory have been finally solved, there remains one upon which the answer has not yet been fully given, namely, the comparative efficiency for memory of things seen and things heard.

There has long been a popular belief that we are distinctly "eye-minded" and much of our present school practice is based upon this belief. Prior to the invention of writing, the memory of things heard must have been highly developed as practically all knowledge had to be received in this way. The art of writing is very young in the history of mankind and to assume the decadence of our natural functions in so short a time is to assume a very rapid process of evolution. Even today, the masses are not given to much reading and depend for most of their information on what they hear.

Summing up the results of the previous experimental work on this subject, we find that the results are all given in terms of group study and take little or no account of individual differences. The author describes an experiment with thirteen summer school students in the University of Colorado as subjects. The details of the experiments are necessarily omitted on account of space. The author recognizes the need of further experimentation but draws the following conclusions from his work.

1. Neither method of presentation, auditory or visual, presents any marked degree of superiority in the rate of learning of meaningful, connected material.
2. Neither method has any distinct advantage over the other in regard to the number of repetitions required for learning.
3. Subsequent to the auditory method of presentation retention appears to be better than after the visual method of presentation.

It is further noted that, generally speaking:

4. The one who learns rapidly and with few repetitions also retains as well or better than the one who learns more slowly and with more repetitions.
5. The one who learns easily by one method also learns easily by the other method, and;
6. The one who retains well through one method retains well through the other method.
7. Age does not greatly affect the ease of learning, but
8. Age does somewhat affect the ability to retain, though this effect is not as great as was expected.

9. A single repetition of the matter after one day, of well learned material, so strengthens the associative processes that there is no marked decrease in the amount retained during the next day, and;
10. A second repetition of the matter after two days assures a large retention for a relatively long time, in this case, one week.
11. The strengthening of the associative processes by a single repetition of the matter after one day is also shown by the decreased time required for reproduction upon the second day.

Because of an insufficient number of subjects, no conclusion could be drawn as regards sex differences.

Very wide differences between individuals are shown both in ease of learning, and in degree of retention.

It is realized that the main conclusion in this paper, viz. that the auditory method of presentation is intrinsically superior for retention to the visual method of presentation, should be verified by further experimentation. It is particularly desirable that younger subjects be employed.

The process of gathering such data from individuals rather than from groups requires an expenditure of much time and labor but it is believed that the results obtained are proportionately more valuable.

THE POTTERY DECORATIONS OF SANTO DOMINGO AND COCHITI PUEBLOS

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Pottery making is still an important industry in at least half of the twenty-five Pueblo villages of New Mexico and Arizona. In pre-Spanish times, the form and decoration of pottery were quite uniform throughout the entire Pueblo area. In later times, but still antedating the coming of the Spaniards of 1540, a distinct type of ware had been developed in each of six sub-areas. The Spanish Conquest, and the Pueblo rebellion which followed it in 1680, resulted in the wiping out of many pueblos, the consolidation of others and a complex migration of families, clans and even of entire villages. In the readjustment which followed, each pueblo began to develop its own type of pottery, which however, shows little or no trace of European influence, either in form or decoration. Not more than thirty elements of design are to be found in all Pueblo pottery decoration. It is the combination and arrangement of these elements and the available colors with which they are painted that gives a distinct character to the work of each pueblo.

A marked difference, for instance, is found in the pottery decorations of Santo Domingo and Cochiti pueblos, though both are of Keres linguistic stock and are situated but seven miles apart. The Santo Domingo decorations are bold and simple, and consist usually of single or double bands of motifs boldly painted in black. The unit of design is usually repeated from three to ten times about the circuit of a bowl or jar, and this repetition of simple elements has led to considerable regularity and accuracy in drawing.

Another type of decoration has developed from the use of plant forms. These vary from highly conventionalized types, repeated within bands, to widely spaced realistic forms. Remrakable ingenuity is shown in the great variety of fanciful forms of leaf and flower, as many as ten varieties sometimes appearing in one plant. High conventionalized birds are frequently used, and there is a marked tendency to combine bird and plant forms. A leafed vine may be used as the wing of a bird, and feathers are occasionally drawn in place of leaves on a vine.

Much less skill is shown in the moulding and decoration of Cochiti pottery. The decoration, like that of Santo Domingo, is done in black alone, but there is less regular repetition of motifs within bands. A great variety of simple symbolic elements are used in narrow borders, below the rims of jars and bowls, and these elements appear in larger and more complex motifs, upon the exterior surface of jars and upon both exterior and interior surfaces of bowls. One distinct feature of Cochiti decoration is the fanciful combination of the cloud, lightning and rain symbol, with plants. In some combinations, plants are shown growing out of clouds; in others the cloud, lightning and rain take the place of flowers upon the plants. Conventional forms of birds, quite distinct from the Santo Domingo forms, are frequently used, in association with flowers.

In conclusion, the pottery decoration of Santo Domingo pueblo is remarkable for the development of bold, simple designs within bands, and the great variety of leaf and flower forms. The decoration of Cochiti pottery is more crudely done, but is of great interest and value because of its fanciful combinations of ancient symbols that have disappeared from the pottery decorations of many other pueblos.

AN EARLY PERIOD OF MIMBRES CULTURE

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During the progress of the excavations of the Museum of New Mexico on Cameron Creek, Grant Co., N. M., in 1923, a very early form of dwell was discovered. It is called the Pit House. These houses were sunk to a depth of three to four feet into the pleistocene gravels covering the mesa ridge projecting into the creek valley. These rooms were approximately eleven by fourteen feet in size; walls accurately cut with well rounded corners; stone walls built upon the gravel edges of the rooms extended high enough to give head room; walls and floors neatly plastered with adobe. Roofs supported with cedar posts. Entrances were excavated stairways leading from the ground levels to the floor levels of the rooms; stairways were also roofed over supporting posts. Fireplaces regularly placed in floor two or three feet in front of the entrance. These rooms were built as single units, two of which in one case were connected with an excavated passage way. The burial of infants was intermural; that of adults in the surface outside the pit rooms. One cyst burial was found, the majority of burials having been made in oval pits of varying depths. Pottery was distinctive in form and decoration. The period of occupation has been carefully estimated to be from 300 B. C. to 1 A. D.

FOUR RESEARCH PROJECTS IN ARCHAEOLOGY

PAUL W. F. WALTER, Secretary, School of American Research,
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The School was enabled to undertake an important excavation in the Mimbres region and the work was entrusted to Mr. Wesley Bradfield of its staff. The site selected was on Cameron Creek, and included a pre-Spanish pueblo location of four community houses and a number of pit dwellings. Something like thirty rooms were cleaned out, in addition to the kiva and several pits. Over two hundred pieces of pottery were secured, some forty pieces being practically intact. Sixteen metates and a hundred and twenty manos, as well as hammers, axes, and other small stone material, were a part of the material brought back to the Museum. Bone awls, shell bracelets, strings of shell beads, shell pendants, several turquoise beads and ear rings, are included in the result of the season's work. The number of skeletons exhumed was a hundred and fifty-four, but many of them were in such poor condition that but few could be examined with minute detail. A hundred and seventeen had bowls or pottery of some kind accompanying the burial. All the skeletons, regardless of the age of the individual, were buried with lower limbs more or less flexed or folded, fully ninety per cent having their knees brought up to the chest, with heels lying against the pelvic bones. Indications point to the Mimbres people have preceded those of the Gila, as the examination of an old village site on the Gila thirty-four miles from Silver City, seemed to show that the Mimbres people had originally occupied it, and that the Gila people had leveled off the old Mimbres ruins and built their pueblo upon them. The same site also seemed to point to the Gila and Casas Grandes cultures as being contemporaneous with each other, and that the designs on the Mimbres pottery had a decided influence in determining many of the designs used later on the Casas Grandes pottery, the date of the latter being tentatively placed at 700 to 900 A. D.

A second project, which had been planned for some years past, was the mapping in detail and excavation of the so called Gran Quivira National Monument, on the Torrance-Socorra County boundary. The Bureau of National Parks helped to finance the undertaking. Altogether $2,000 were available, and the result was quite gratifying. Preliminary to the excavation, the four hundred acres of land included in the National Monument and the site owned by the School of American Research were fenced as a protection against vandals. Several large reservoirs were located, solving the mystery that has always existed as to the source of water supply for this pueblo. The water impounded in these reservoirs could be released at any time to flow into smaller reservoirs near the pueblo, from which the water was carried over the hanging gardens on the slopes of the hill. These reservoirs had a capacity of about 100,000,000 gallons. Excavations were commenced in the original plaza, and a new type of kiva uncovered. It was found that under the walls of the buildings, which show above the ground, there are the remains of older walls and buildings. The skeleton material from thirty-nine burials is of special interest, as these are the first skeletons of the Piro people, a tribe now entirely extinct, which have been obtained for scientific study.

A third project was a survey from an architectural standpoint of the Franciscan missions of New Mexico. The material gathered will be of the utmost value in restoration work on the other missions.

A fourth project was the mapping out of a proposed National Park, which is to extend from the Rio Grande to the Jemez River, and from Cochiti on the south to and including the Valle Grande on the north. This region includes thousands of cave and cliff dwellings, as well as the ruins of big community houses. The Valle Grande itself is one of the largest craters on this continent. The scenery is magnificent, and altogether the park would be unique and one of the most interesting of the entire national park system.

THE STATE UNIVERSITY
OF NEW MEXICO

ALBUQUERQUE (ALTITUDE 5,000 FEET)
DAVID S. HILL, PH. D., LL. D., PRESIDENT

COLLEGE OF ARTS AND SCIENCES

COLLEGE OF ENGINEERING

SUMMER SESSION, 1924

1. The State University is the only institution in New Mexico now accredited by the Commission on Higher Education of the North Central Association as a College and University of standard grade. No preparatory students accepted.

2. The Faculty includes men and women possessing credentials of adequate graduate training from universities, such as Columbia, Harvard, Cornell, Clark, Stanford, California, Wisconsin, Michigan, Illinois, Ohio, Chicago, Pennsylvania, Princeton and Bryn Mawr.

3. The State University has no deficits and is operating efficiently. During the past four years four buildings, a grandstand, a powerful radio station and a steam plant have been erected and paid for. Laboratories and library of over forty thousand volumes, constantly growing, are available for the use of the students.

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